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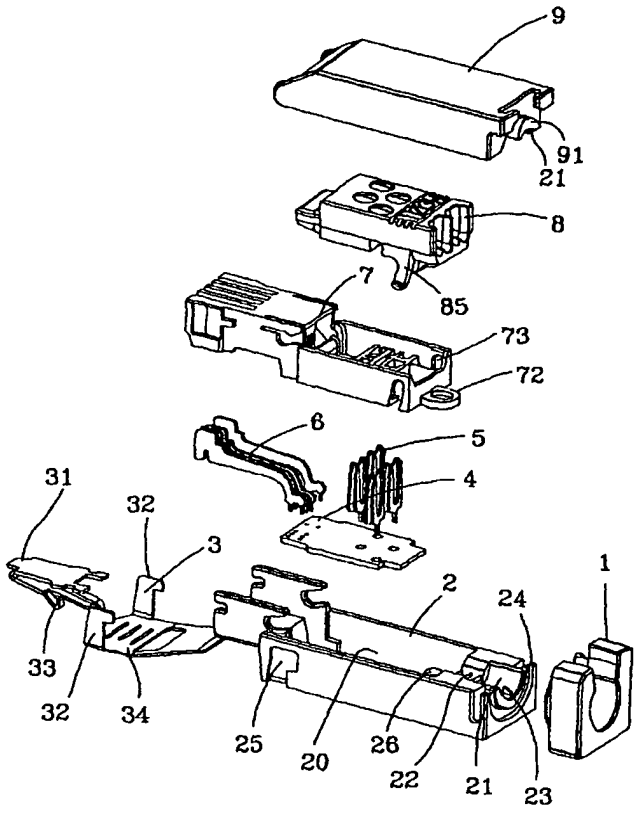
(54) Title: ELECTRICAL PLUG FOR DATA TRANSMISSION IN AN INDUSTRIAL ENVIRONMENT



(57) Abstract: Electrical plug for data transmission in an industrial environment has a connection region for making contact without tools between at least one shielded conductor or a plurality of conductors of a shielded cable and first electrical contact (5). A plug head (10) having second electrical contacts (6) for introduction into a plug receiver is also provided. A connection part (4) conductively connects the first and second electrical contacts (5, 6), and shielding means are connected to the shielding means of the conductor or cable.

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ELECTRICAL PLUG FOR DATA TRANSMISSION IN AN INDUSTRIAL ENVIRONMENT

The invention relates to an electrical plug for data transmission in an industrial environment. The plug has a connection region for making the contact for a conductor, a plug head for introduction into a plug receiver and a shielding means.

US 5,667,402 discloses an electrical plug receiver which is connected by way of a circuit card to insulation displacement contacts which accept cables by way of pivotal covers. This makes it possible to connect a modular jack or similar connector to a cable. This also makes it possible for modular jack plug connectors to be used in industrial applications.

In light of the prior art, the object of the present invention is to provide an electrical plug which is suitable for data transmission in industrial-type environments and which can be mated to a corresponding modular jack provided for industrial use.

This object is achieved by an electrical plug having the features of Claim 1 or Claim 2. Advantageous further developments are specified in the sub-claims.

The electrical plug as described herein is used for data transmission in an industrial environment such as serial field bus networks in industrial use with PC-based LAN systems, for example in an Ethernet environment. For this purpose, the electrical plug acts as an adapter by corresponding on the plug head side to the standardised LAN connection and by being able to make contact on the connection side for four-core conductors suitable for field bus applications. The connection principle of the plug head can be in the form of an RJ45 plug, or another type of plug (for example a round plug).

Solutions up until now have additionally needed a special connection socket for this purpose, which provides

the adapter function between the technically higher-quality and thicker field bus line and the link, which is of technically simpler construction, to a PC or similar applications in an Ethernet environment.

It is advantageous that a direct connection is possible from machines to be controlled to a network, using a solid or flexible conductor specified for a field bus. The intermediate socket, used as an adapter up until now, between the LAN and field bus networks is dispensed with when the electrical plug according to the invention is used. The electrical plug according to the invention is easy to handle and can be connected to a cable using conventional tools.

For industrial applications, it is advantageous that a robust latching means is provided. Moreover, the overall concept of the electrical plug provides a particularly robust construction.

It is advantageous that it is possible to compensate for interference signals.

Moreover, it is advantageous that the electrical contact for the conductors is made by means of insulation displacement technology using a pivotal cover and can thus be performed without tools. It is also possible to provide a plurality of pivotal covers. This has the advantage that the conductors can be applied individually.

Instead of insulation displacement contacts, it is also advantageous to provide piercing contacts, which also make it possible to make contact without tools.

It is furthermore advantageous that, because of the pivotal cover of transparent construction, it becomes possible to check the position of the connected conductors. To make it more easily possible to discern the position, magnifying glasses may be constructed in the transparent region.

Furthermore, it is advantageous that a shield plug is specified.

It is furthermore advantageous that the electrical plug has a strain relief means which is also extremely robust and very easy to handle.

Example embodiments of the invention will now be described with reference to the figures:

Figure 1 is an exploded perspective view of a first embodiment of an electrical plug according to the invention;

Figure 1a is a perspective view, depicting two contacts and a connection part of the plug according to the invention.

Figure 2 is a perspective view of the electrical plug of Figure 1 in the open position;

Figure 3 is an enlarged perspective view of respective insulation displacement contacts of the electrical plug of Figure 1;

Figure 4 is a perspective view of the electrical plug of Figure 1 with a latching spring attached;

Figure 5 is a perspective view of the electrical plug in the first assembly step;

Figure 6 is a perspective view of the electrical plug in the second assembly step;

Figure 7 is a perspective view of the electrical plug according in the third assembly step;

Figure 8 is a perspective view of the electrical plug in the last assembly step;

Figure 9 is a partial perspective view of the electrical plug with the clamping piece not yet fixed;

Figure 10 is a partial perspective view of the electrical plug with the clamping piece partially assembled;

Figure 11 is a partial perspective view of the electrical plug with the clamping piece fully assembled;

Figure 12 is a diagrammatic illustration of the electrical plug on the cable side, with the clamping piece in the first position;

Figure 13 is a diagrammatic illustration of the electrical plug on the cable side, with the clamping piece in the second position;

Figure 14 is a diagrammatic illustration of the electrical plug on the cable side, with the clamping piece in the third position;

Figure 15 is a diagrammatic illustration of the electrical plug on the cable side, with the clamping piece in the final position;

Figure 16 is an exploded perspective view of a second embodiment of an electrical plug according to the invention;

Figure 17 is a perspective view of the electrical plug of Figure 16, in the completely open position with conductor ends inserted;

Figure 18 is a perspective view of the electrical plug of Figure 16, with the pivotal cover closed and the cable introduced;

Figure 19 is a perspective view of the electrical plug of Figure 16, in the closed but not yet locked condition; and

Figure 20 is a perspective view of the electrical plug of Figure 16, in the completely closed and locked position.

A first example embodiment of the invention will now be described with reference to Figures 1 to 15. The structure of the electrical plug will first be described with reference to Figures 1 to 4. Then, the assembly of the electrical plug to a shielded cable having four conductors will be described with reference to Figures 5 to 8. The securing of the clamping piece will then be described with reference to Figures 9 to 11. Finally, the rotation of the clamping piece will then be described with reference to Figures 12 to 15.

Figure 1 shows an exploded illustration of the electrical plug according to the first embodiment. The following parts can be seen: a clamping piece 1 which is part of a strain relief device; a lower shield housing 2; a

metal latching spring 3 which serves to latch the electrical plug in a plug receiver; a connection part 4 which serves to conductively connect the first and second contacts; first electrical contacts 5, which are constructed as insulation displacement contacts; second electrical contacts 6; an insert housing 7; a pivotal cover 8; and an upper shield housing 9.

The shielding means thus comprises a lower shield housing 2 and an upper shield housing 9. The upper shield housing 9 is mounted on the lower shield housing 2 in such a way that it can be pivoted open. The housings can be secured together such that they cannot become inadvertently detached. The lower shield housing 2 serves to receive the individual components of the electrical plug. For this purpose, it has a trough-shaped receiver 20. Moreover, it has at the cable end a substantially semi-cylindrical recess to act as the cable receiver 21. A semi-cylindrical recess of this kind acting as a cable receiver 21 is also provided on the upper shield housing 9. These semi-cylindrical recesses have transverse ribs 22 for making the contact with the shielding means of the conductor or cable. Moreover, clamping mandrels 23 are provided in this semi-cylindrical recess 21, these being part of the strain relief device and engaging the outer sheath of the cable when the clamping piece 1 is applied appropriately. Also provided on the lower shield housing 2 is a holding device 24 for mounting the clamping piece 1.

Furthermore, the lower shield housing has on each of its opposing outer sides recesses 25 for securing the metal latching spring 3.

In the first embodiment, the connection part 4 is constructed as a rigid circuit card. It has metallized bores into which the first and second electrical contacts 5, 6 can be introduced by means of appropriate pin regions. It is also possible to construct the connection part 4 as a flexible foil board or punched grid. The electrical contacts

5, 6 can be connected to the connection part 4 by means of reflow soldering, SMD soldering, flow soldering or other insert technique.

As illustrated in Figure 1a, instead of a separate connection part 4 it is also possible for the latter to be constructed as a stamped and formed part 40 in which the contacts 5 and 6 are integrally attached. A part of this type is particularly simple to manufacture, and the assembly step for assembling the electrical contacts to the connection part is eliminated.

The first electrical contacts 4 in Figure 1 are constructed as insulation displacement contacts which are folded over. It is therefore possible to terminate a plurality of conductors to one insulation displacement contact.

It is also possible to provide on the connection part 4 an arrangement for compensating for interference, for example in the form of capacitors or in the configuration of the conductor traces on the connection part 4.

The insert housing 7 is inserted from above over the first and second electrical contacts 5, 6 onto the connection part 4. The insert housing also co-operates with the receiver 20 of the lower shield housing 2. Together with the second electrical contacts 6, the insert housing 7 forms the plug head 10, which can be introduced into a complementary receiver, for example a modular jack.

Provided on the underside of the insert housing 7 is a recess 71 (Figure 4) which serves to secure the tab 31 on the latching spring 3. The latching spring 3 is thus secured to the electrical plug by means of the lateral tabs 32 and the front tab 31. The latching spring has two latching hooks 33 and an actuating handle 34 by means of which the latching hooks are actuable and the plug is detachable from a complementary receiver.

The insert housing 7 can for example have an extension 72 having a bore which co-operates with a post 26 in the

lower shield housing 2. The post 26 can be hot-caulked in order to secure the insert housing 7 in the lower shield housing 2. Alternatively, the insert housing 7 can be latched to the shield housing 2.

The pivotal cover 8 can for example be made from a transparent material in order to allow the termination of the insulation displacement contact to be monitored. It is also possible to construct, from the transparent material, viewing windows 81 (Figure 2) with a magnifying effect. The pivotal cover 8 has individual receivers 82 for receiving conductor ends. The individual receivers 82 have introduction funnels 83. It is possible to provide labelling 84 on the pivotal cover 8. By pivoting the pivotal cover 8, the conductors introduced into the individual receivers 82 are brought into contact with the insulation displacement contacts 5. The pivotal cover 8 is secured pivotally to the insert housing 7, having a stop in both the open and the closed position. Latching arms 85 which co-operate with corresponding latching openings 73 in the insert housing 7 are provided to latchingly maintain the pivot cover in the closed position.

The clamping piece 1 serves to close the upper and lower shield housings 2, 9. The clamping piece 1 has a through bore 101 which allows it to be turned by means of a screwdriver.

All the components of the electrical plug are assembled with one another such that they cannot be inadvertently detached.

With reference to Figures 5 to 8, the assembly of a cable 11 which shielding means 12 and four conductors 13 to the electrical plug according to the invention will now be described. The cable 11 must be freed of its outer sheath in certain regions and the shielding means 12 exposed, and in certain other regions the shielding means must also be removed and the conductors 13 exposed. The exposed conductors 13 are then pushed into the individual receivers

82. A stop is provided on the pivotal cover 8 for the cable 11. Once the conductors 13 have been introduced far enough into the pivotal cover 8, the latter is pivoted into the insert housing 7, resulting in the conductors 13 being brought into the contact position by means of the insulation displacement contacts. Once the pivotal cover 8 is pivoted down, the cable is located in the cable receiver of the lower shield housing 2. The upper shield housing 9 can then be swung onto the lower shield housing 2. The plug is now closed but not yet locked. By turning the clamping piece 1, the two shield housings 9 and 2 are locked. The plug is now fully assembled on the cable and secured.

With reference to Figures 9 to 11, the way the clamping piece 1 is secured to the lower shield housing 2 will now be described. The clamping piece 1 is latched onto the lower shield housing 2 at a defined angle of rotation. Then the clamping piece is turned such that the opening slot 102 of the clamping piece extends coaxially with respect to the axis of the receiving opening 21 of the shield housing 2. The clamping piece 1 is then secured to the lower shield housing 2 such that it cannot be inadvertently detached.

Referring to Figures 12-15, the clamping piece serves not only to secure the two shield housings 2, 9 to one another, but also ensures strain relief. The clamping piece 1 has a peripheral collar 103 with latching and guide elements. When the clamping piece is turned, this collar co-operates with a journal 91, which bears the cable receiver 21, on the upper shield housing 9. When the clamping piece 1 is turned, pressure is exerted on this journal 91 and the two receivers 21 are pressed against one another by means of the holding mandrels 23 and thus against the cable. In Figures 12 to 15, no cable is illustrated, for the sake of better clarity. In Figure 15, the secured position of the clamping piece 1 is illustrated.

With reference to Figures 16 to 20, a example embodiment of the invention will now be described. This

second embodiment differs from the first embodiment with respect to the connection part. The connection part 4' is constructed as a flexible circuit card. Moreover, the lower shield housing 4' is not constructed in one piece as in the first embodiment, but rather a lower shield plate 2' is provided and an insert housing 7' reaches around the lower shield plate 2' in the manner of a hoop. Here too, insulation displacement contacts 5' are provided and are held in a mounting 51. A pivotal cover 8' applies the conductors 13' of the cable 11' to the insulation displacement contacts 5'. The upper shield housing 9', the lower shield plate 2' and the insert housing 7' are held together by a locking piece 1'. This locking piece can be slid on axially and, by means of shoulders 104', engages in corresponding grooves 92' in the upper shield housing 9'. A separate housing head 12' is provided, in which the second electrical contacts 6' are pre-assembled.

In Figures 17-20, the assembly of a cable 11' in an electrical plug in accordance with the second embodiment is illustrated in individual assembly steps. Initially, the conductors 13' are introduced into the pivotal cover 8'. Then the latter is pivoted down and consequently the contact is made between the conductors and the insulation displacement contacts 5'. After this, the upper shield housing 9' is pivoted onto the lower shield plate 2' and the locking piece 1' is pushed into its final position.

CLAIMS

1. An electrical plug for data transmission in an industrial environment,
comprising

- a connection region for making contact without tools between at least one shielded conductor or a plurality of conductors of a shielded cable and first electrical contacts (5),
- a plug head (10) having second electrical contacts (6) for introduction into a plug receiver,
- a connection part (4) for conductively connecting the first and second electrical contacts (5, 6), and
- a shielding means which can be connected to the shielding means of the conductor or cable.

2. An electrical plug for data transmission in an industrial environment,
comprising

- a connection region for making contact without tools between at least one shielded conductor or a plurality of conductors of a shielded cable and first electrical contacts (5),
- a plug head (10) having second electrical contacts (6) for introduction into a plug receiver,
- a connection part (40) which is constructed in one piece with the first and second electrical contacts (5, 6), and
- a shield means which can be connected to the shield means of the conductor or cable.

3. An electrical plug according to one of Claims 1 or 2, characterised in that the connection region has insulation displacement contacts (5) or piercing contacts.

4. An electrical plug according to Claim 3, characterised in that the connection region has one or more pivotal covers (8).

5. An electrical plug according to Claim 4, characterised in that the pivotal cover (8) has individual receivers (82) for receiving the conductor ends, and in that the latter can be brought into contact with the insulation displacement contacts (5) by pivoting the pivotal cover (8).

6. An electrical plug according to Claim 4, characterised in that the pivotal cover (8) is made of transparent material, at least in certain regions.

7. An electrical plug according to Claim 6, characterised in that the pivotal cover (8) has a transparent region having a magnifying glass (81).

8. An electrical plug according to Claim 5, characterised in that the individual receivers (82) have introduction funnels (83).

9. An electrical plug according to Claim 3, characterised in that the insulation displacement contacts (5) are constructed as contacts folded double.

10. An electrical plug according to one of Claims 1 or 2, characterised in that the shielding means comprises a lower shield housing (2) and an upper shield housing (9), it being possible to pivot the latter up.

11. An electrical plug according to Claim 10, characterised in that the upper and lower shield housings (2,9) each have a semi-cylindrical recess mutually fitting onto one another and acting as the cable receiver (21), having transverse

ribs (22) for making the contact for the shielding means of the conductor or cable.

12. An electrical plug according to Claim 10, characterised in that the shield housings (2, 9) are constructed as die-cast housings or metallized synthetic housings or shield plates which are laid or placed on/into synthetic housings.

13. An electrical plug according to Claim 1, characterised in that the connection part (4) is constructed as a flexible circuit card or foil board, punched grid or rigid circuit card.

14. An electrical plug according to Claim 1, characterised in that the connection part (4) has means for compensating for interference signals.

15. An electrical plug according to Claim 1, characterised in that a metal latching spring (3) is provided for latching to a complementary mating plug.

16. An electrical plug according to Claim 1, characterised in that within the plug head (10) selective equipping with the second contacts (6) is possible.

17. An electrical plug according to Claim 1, characterised in that a strain relief device is provided.

18. An electrical plug according to Claim 17, characterised in that the strain relief device has clamping mandrels (23) in the cable receivers (21).

19. An electrical plug according to Claim 18, characterised in that a clamping piece (1) is provided that by means of which the cable receivers (21) may be pressed against one another.

20. An electrical plug according to Claim 19, characterised in that the clamping piece (1) is moved from the relieved to the clamped position by being turned.

21. An electrical plug according to one of the preceding claims, characterised in that before assembly of the conductors all the individual parts are secured to one another such that they cannot be detached inadvertently.

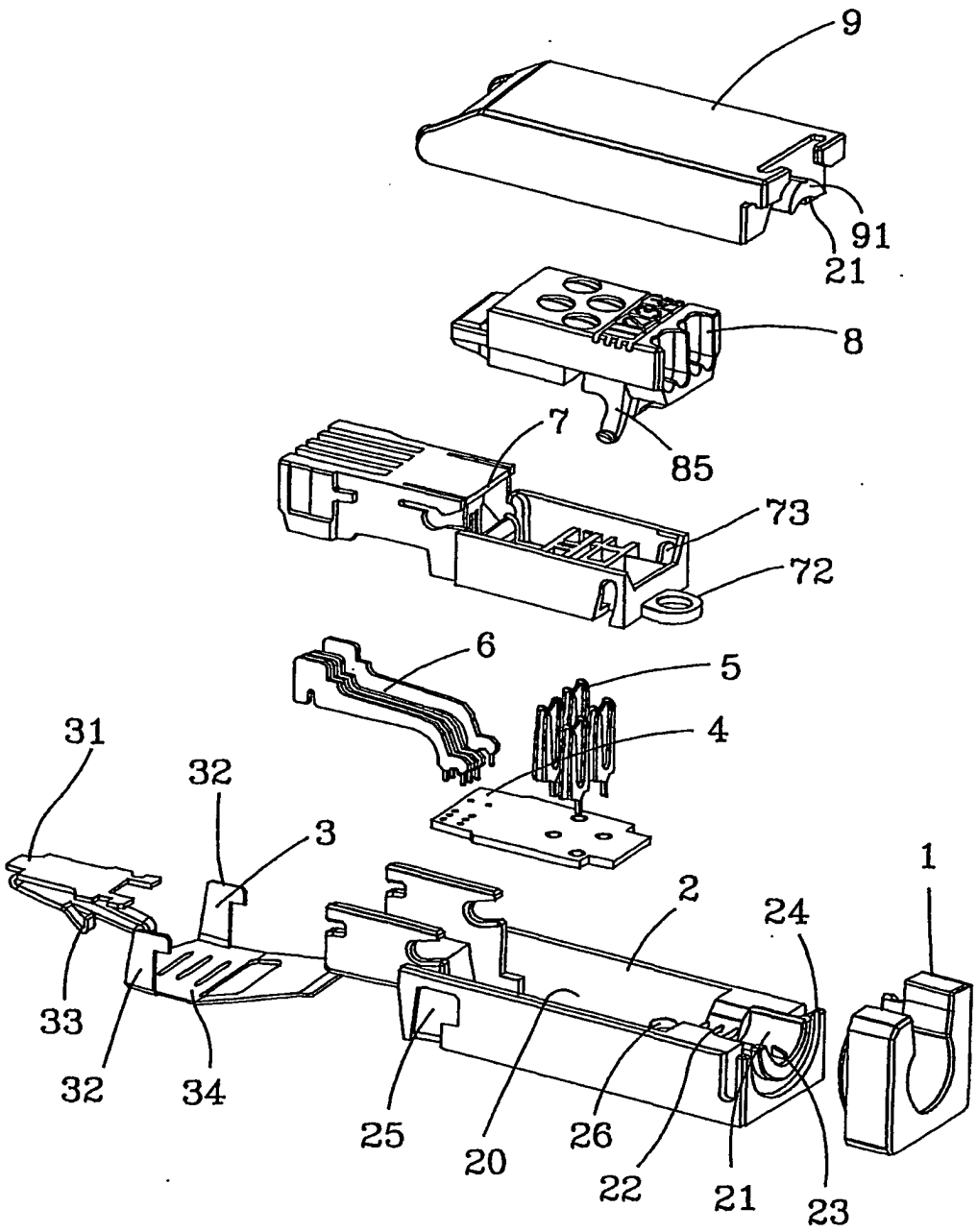


Fig. 1

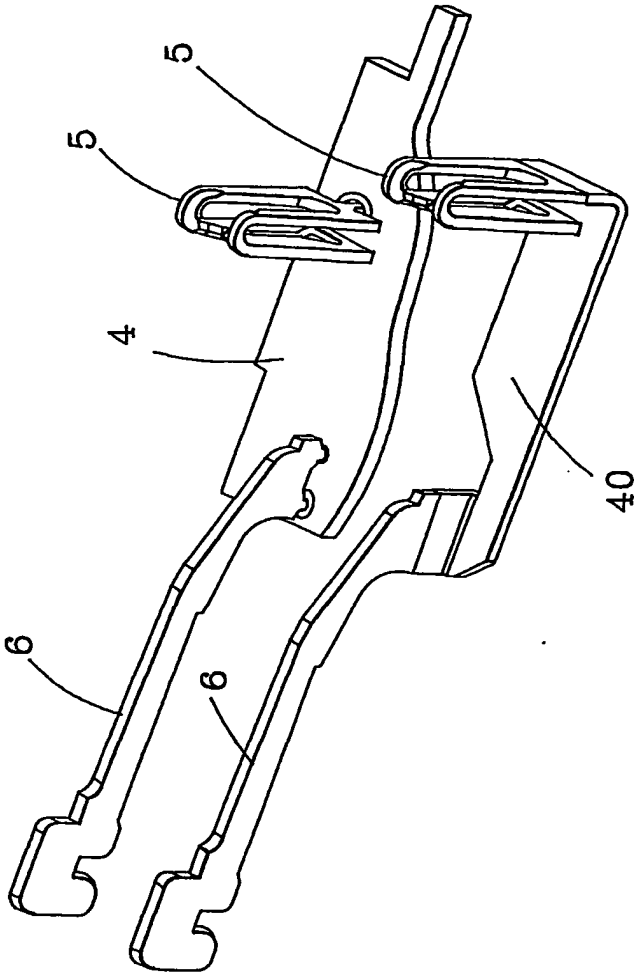


Fig. 1a

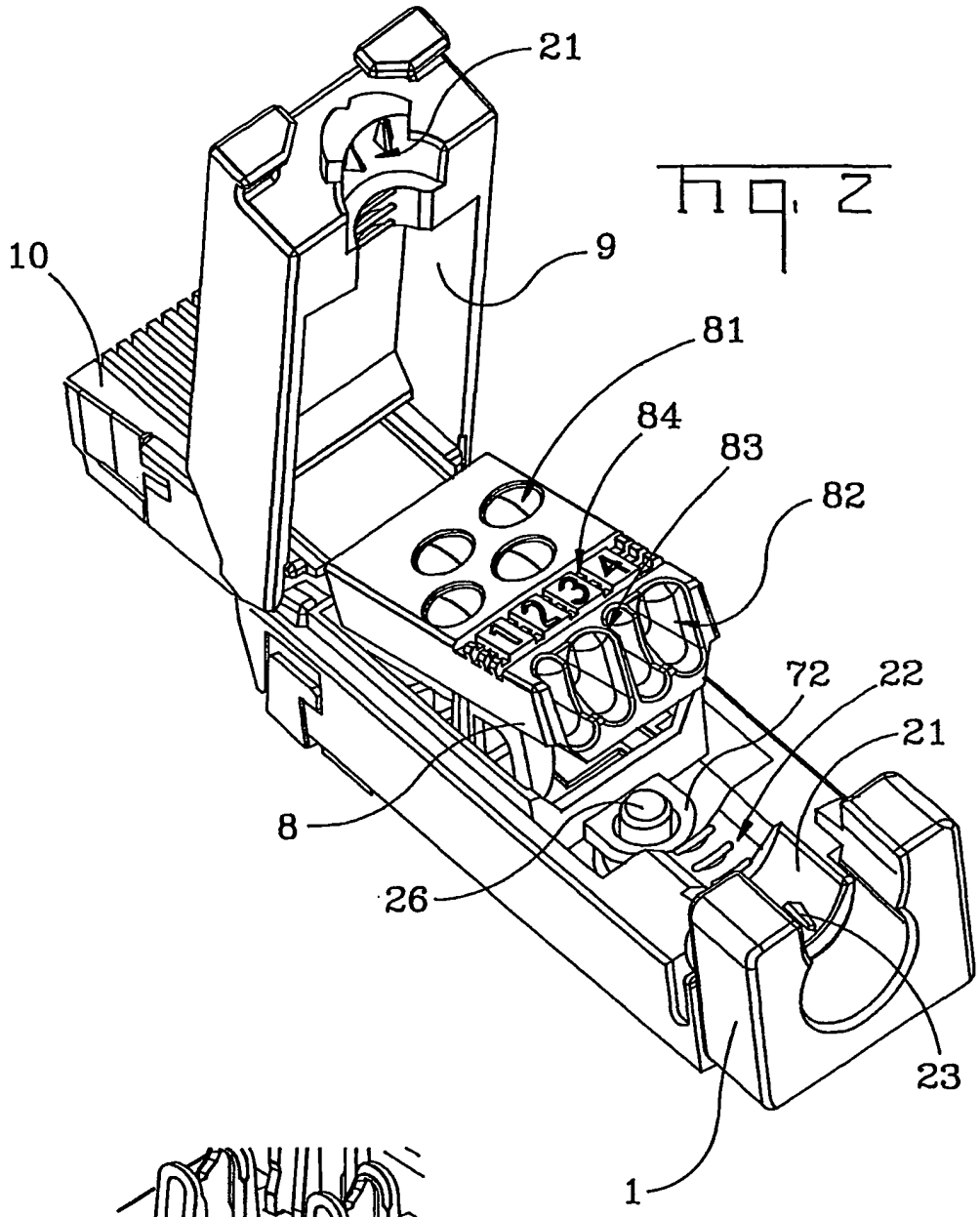


Fig. 2

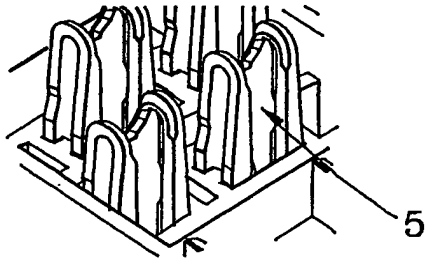


Fig. 3

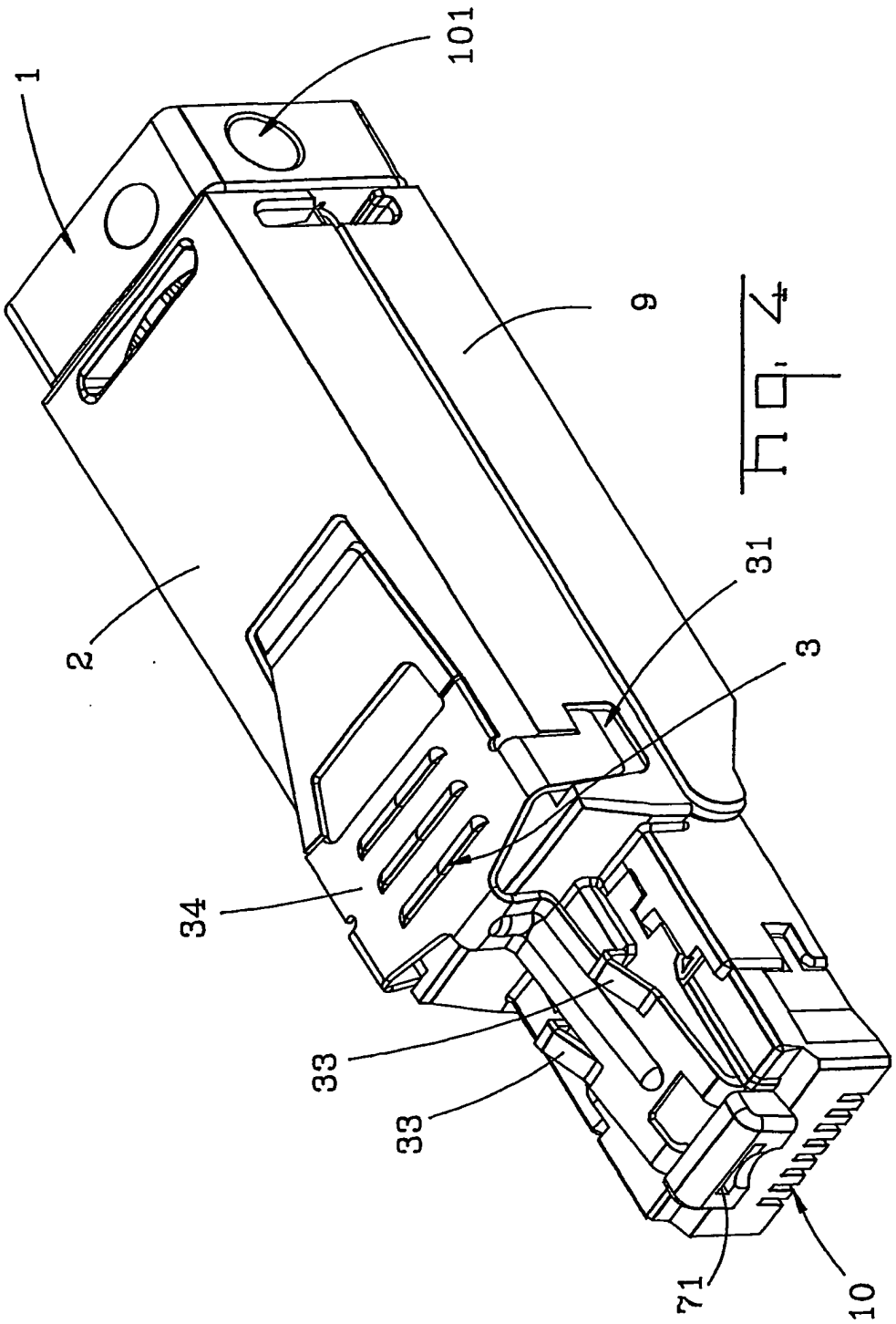


Fig. 4

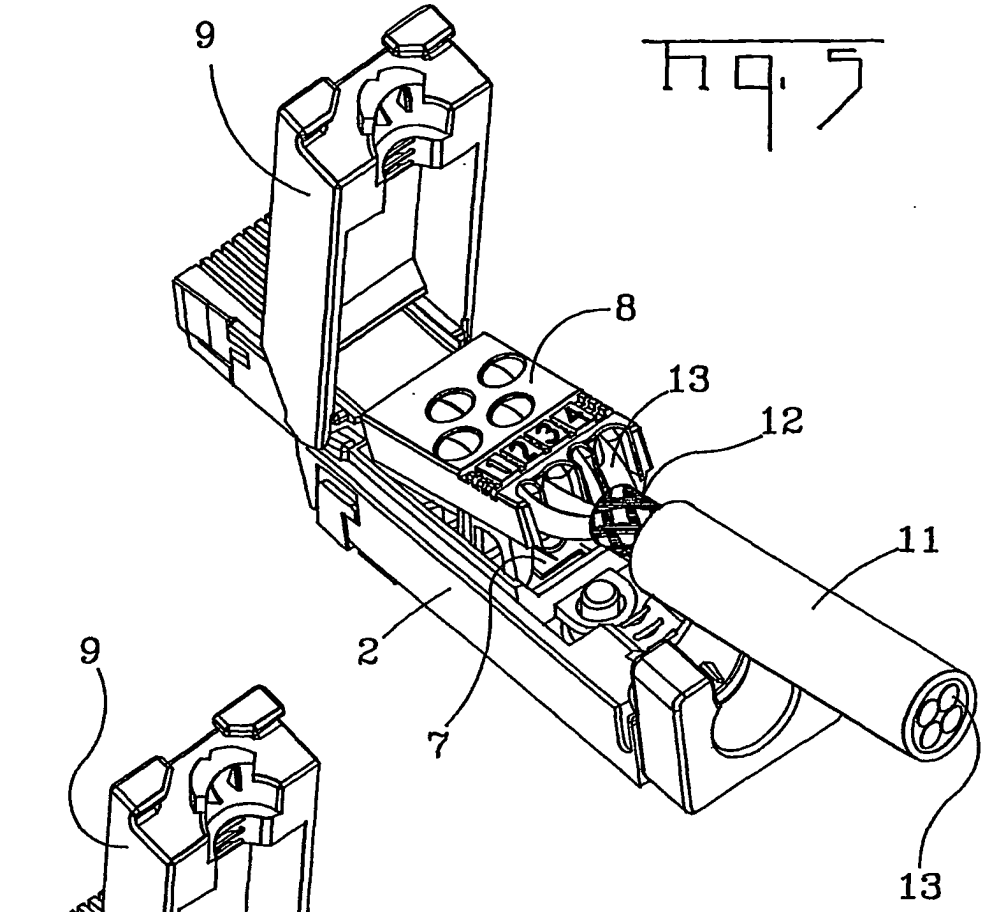


Fig. 5

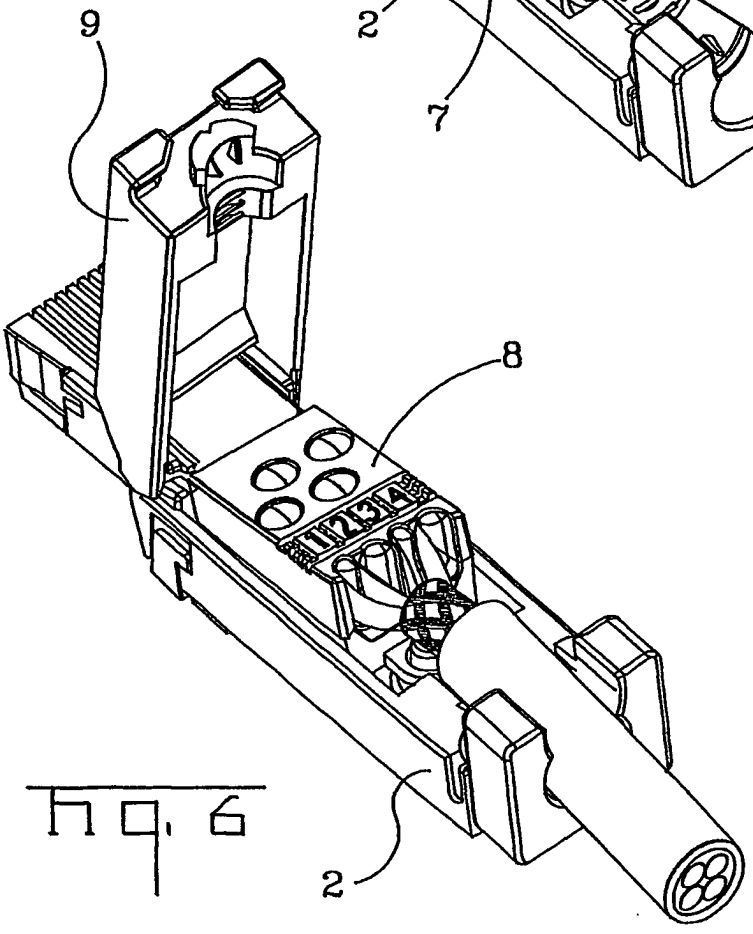


Fig. 6

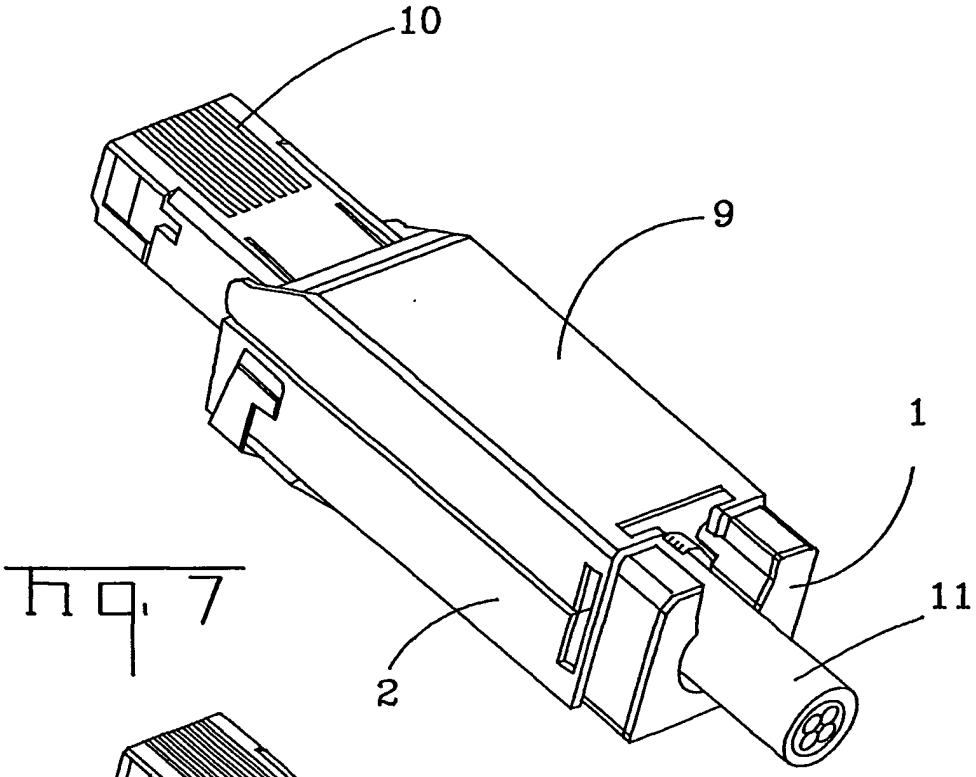


Fig. 7

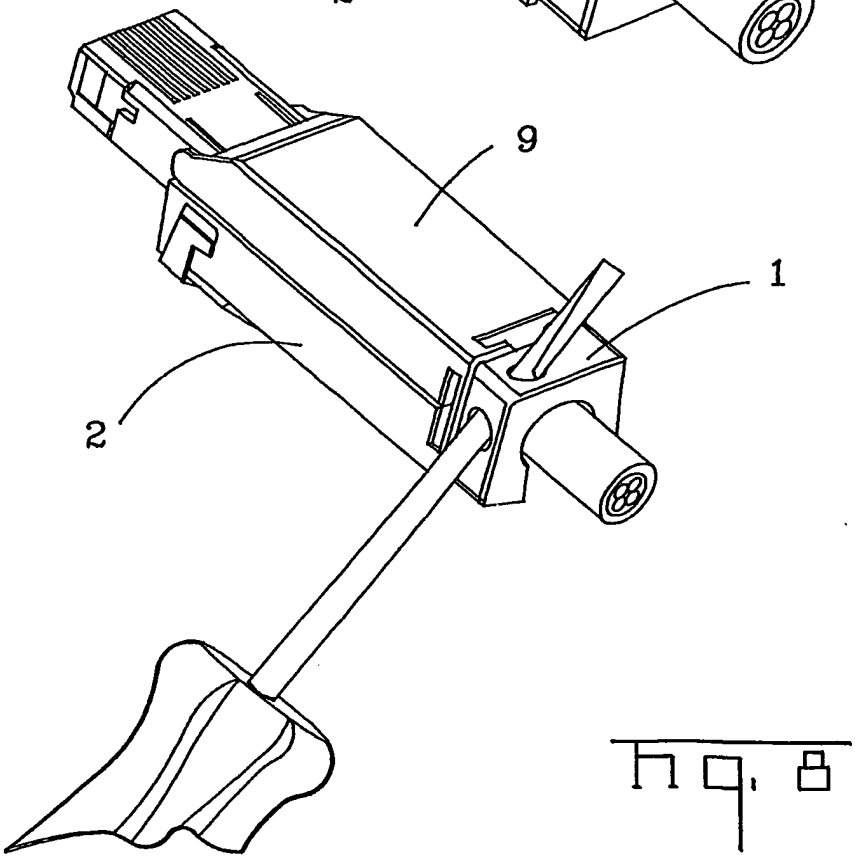


Fig. 8

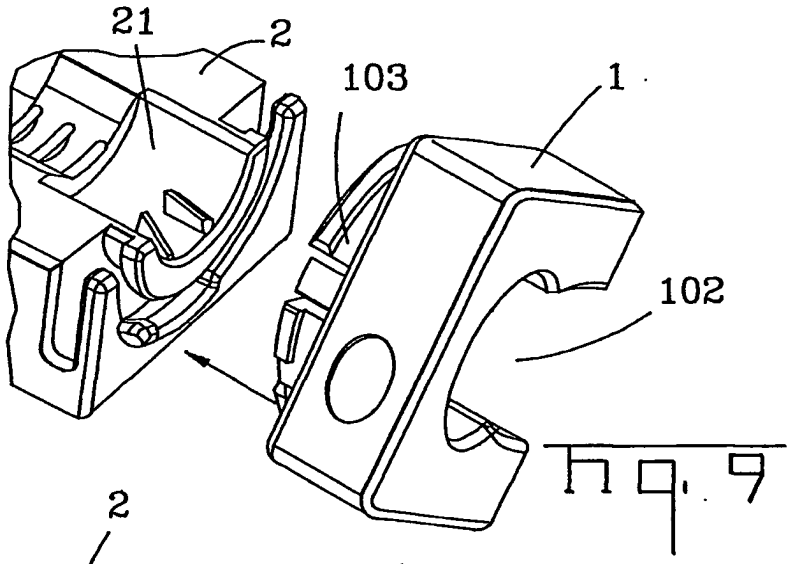


Fig. 9

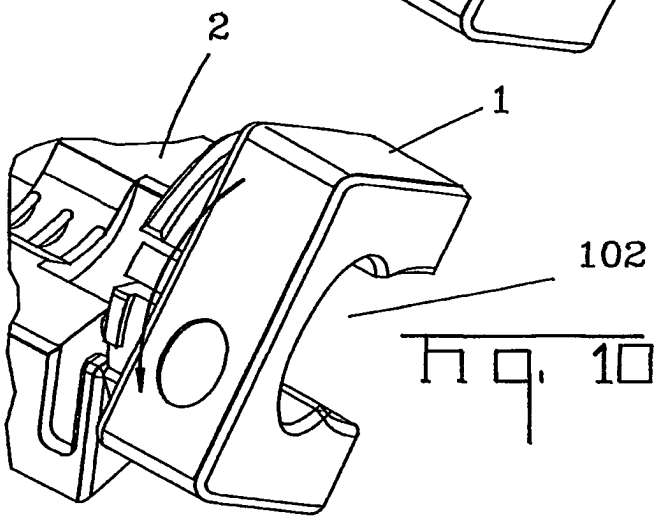


Fig. 10

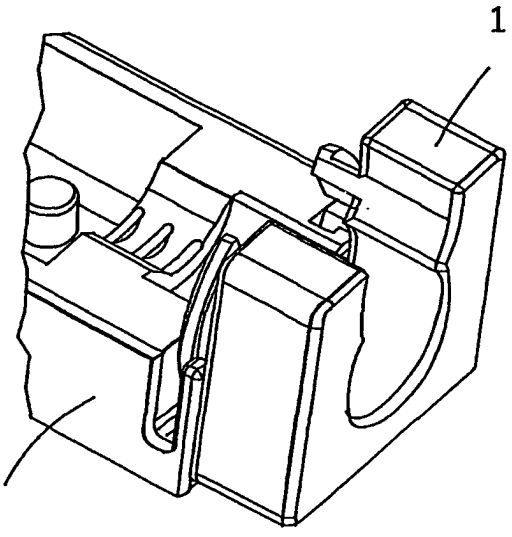


Fig. 11

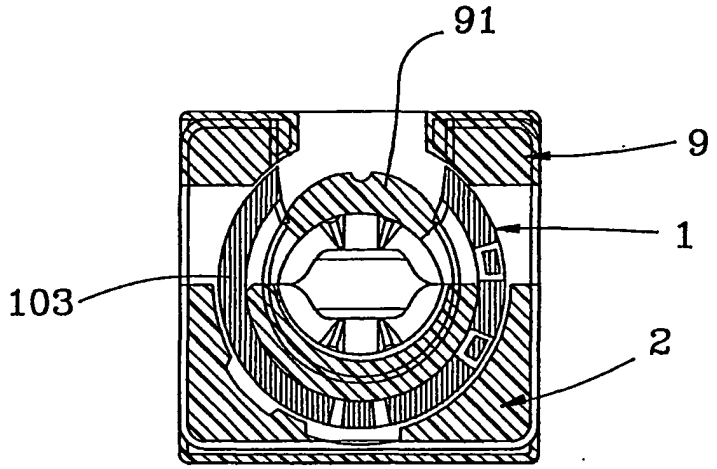


Fig. 12

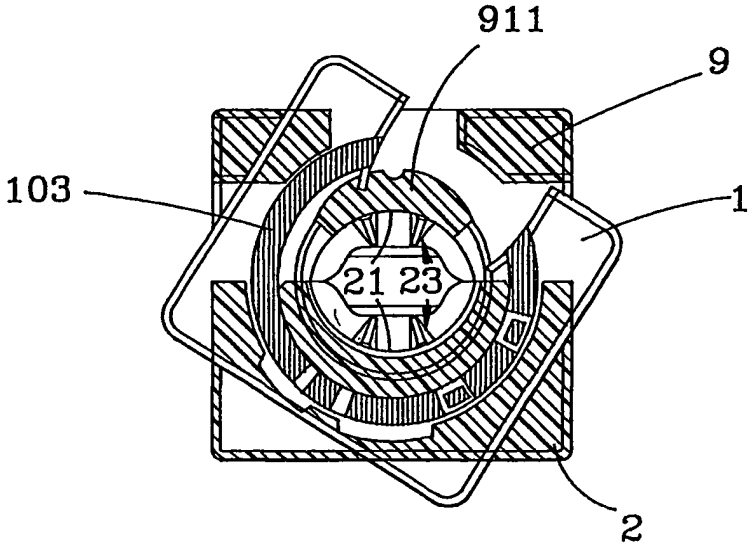


Fig. 13

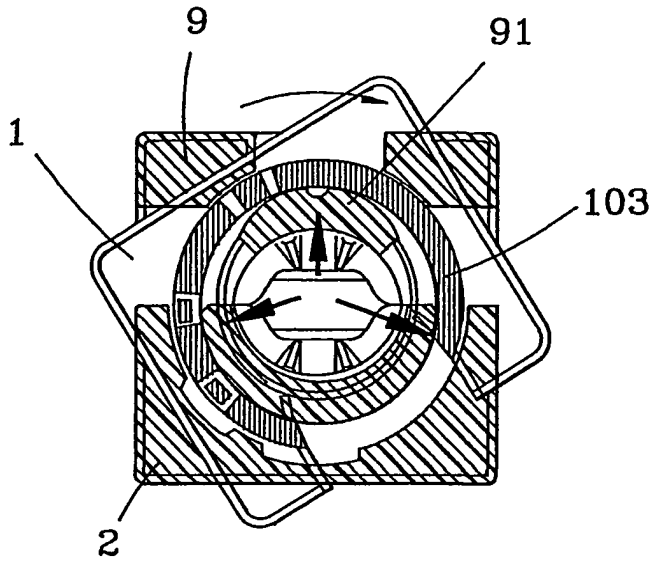


Fig. 14

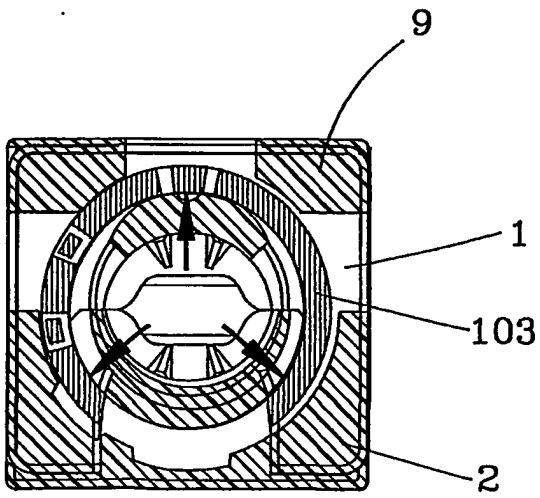


Fig. 15

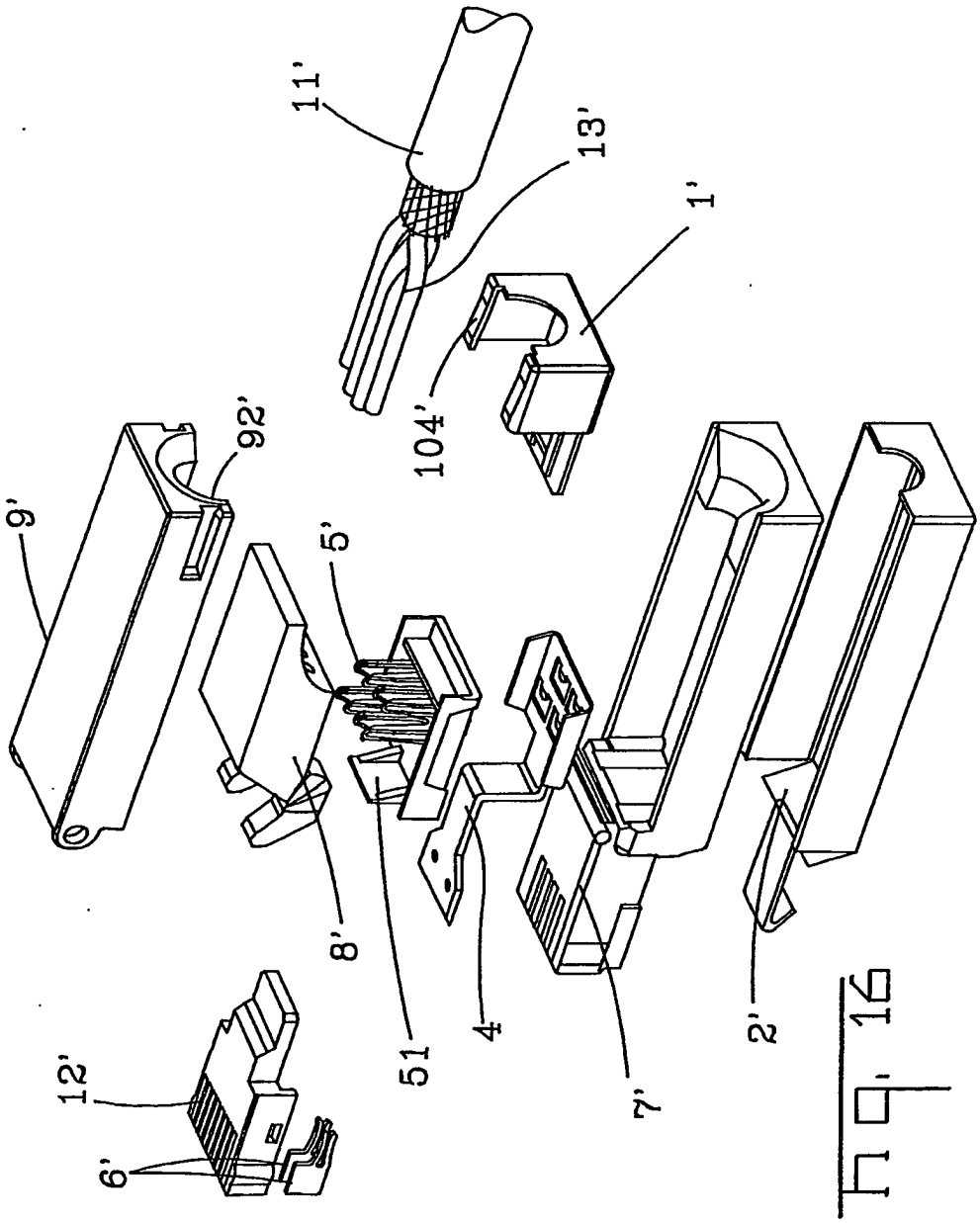


Fig. 16

Fig. 17

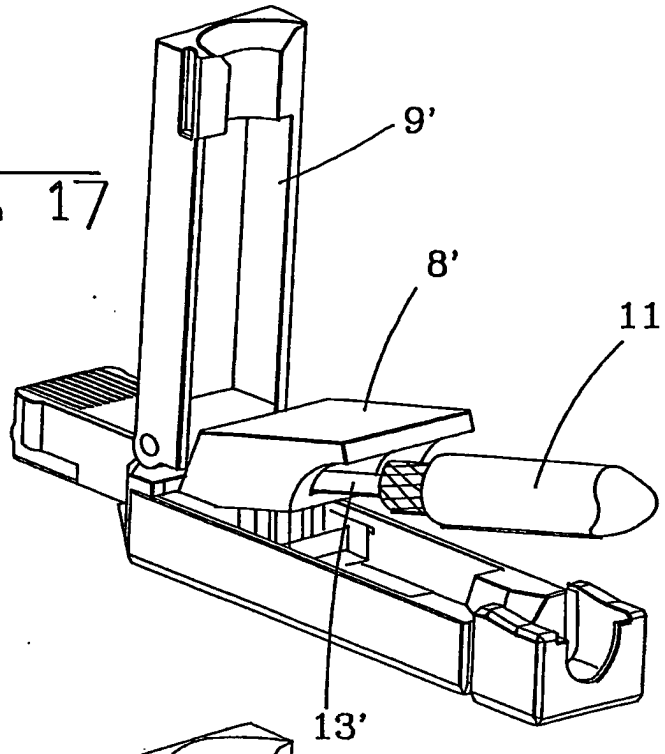
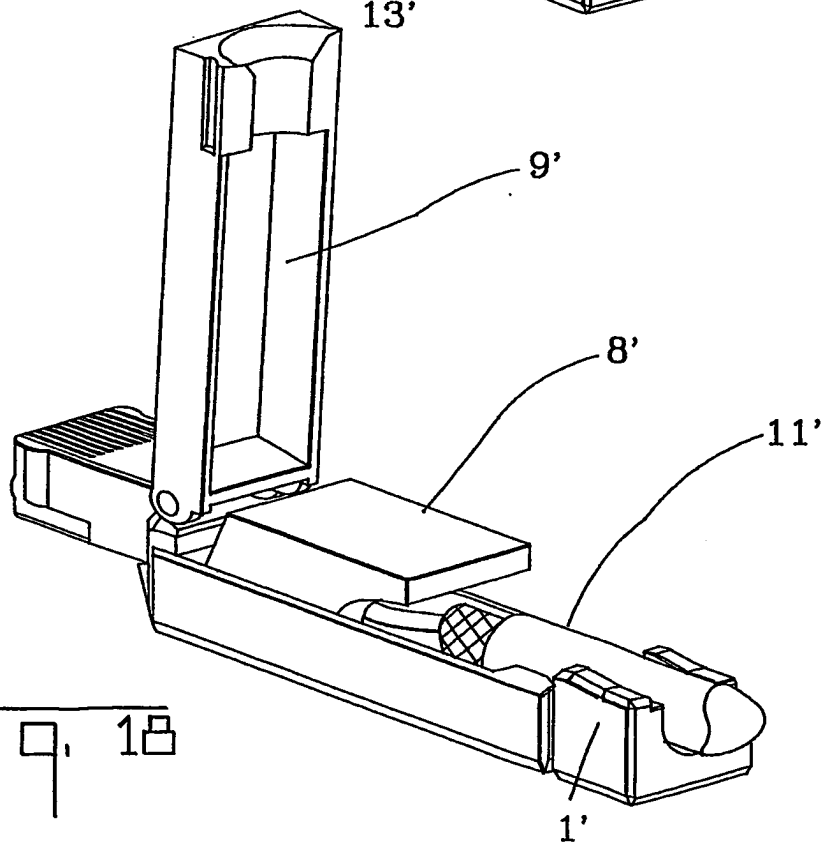


Fig. 18



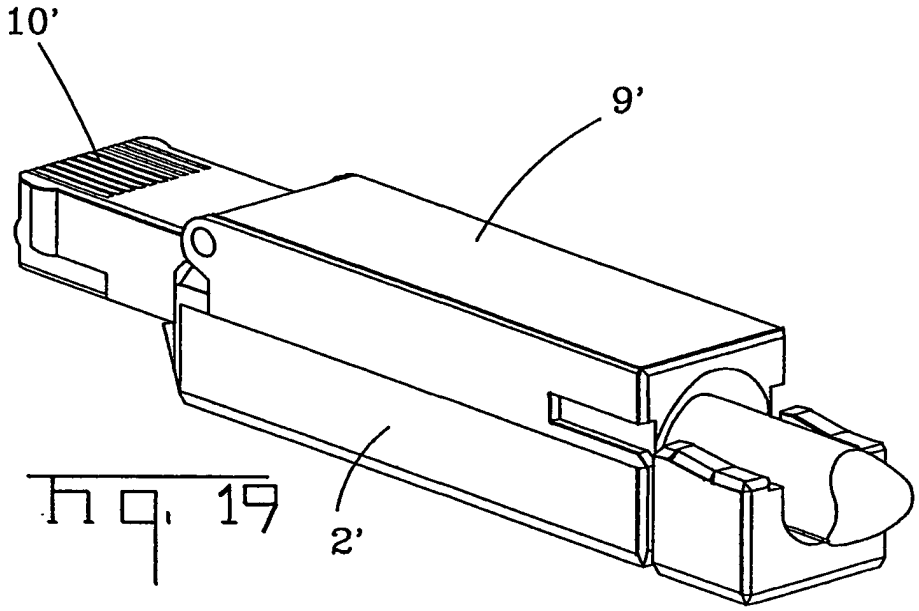


Fig. 19

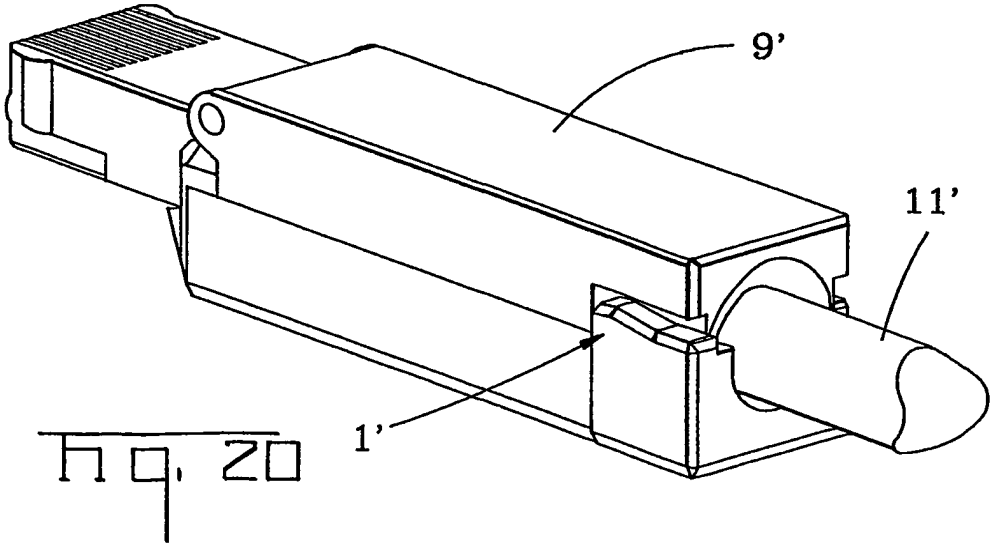


Fig. 20

INTERNATIONAL SEARCH REPORT

Inter _ Application No
PCT/IB 01/01444

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01R4/24 H01R13/58

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 681 180 A (RODRIGUES JULIO F) 28 October 1997 (1997-10-28) column 2, line 66 -column 10, line 34	1-3, 10-12, 16-19 4,5,9, 14,15, 20,21
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 October 2001	16/10/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bertin, M

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INTERNATIONAL SEARCH REPORT

Inte _ al Application No
PCT/IB 01/01444

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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